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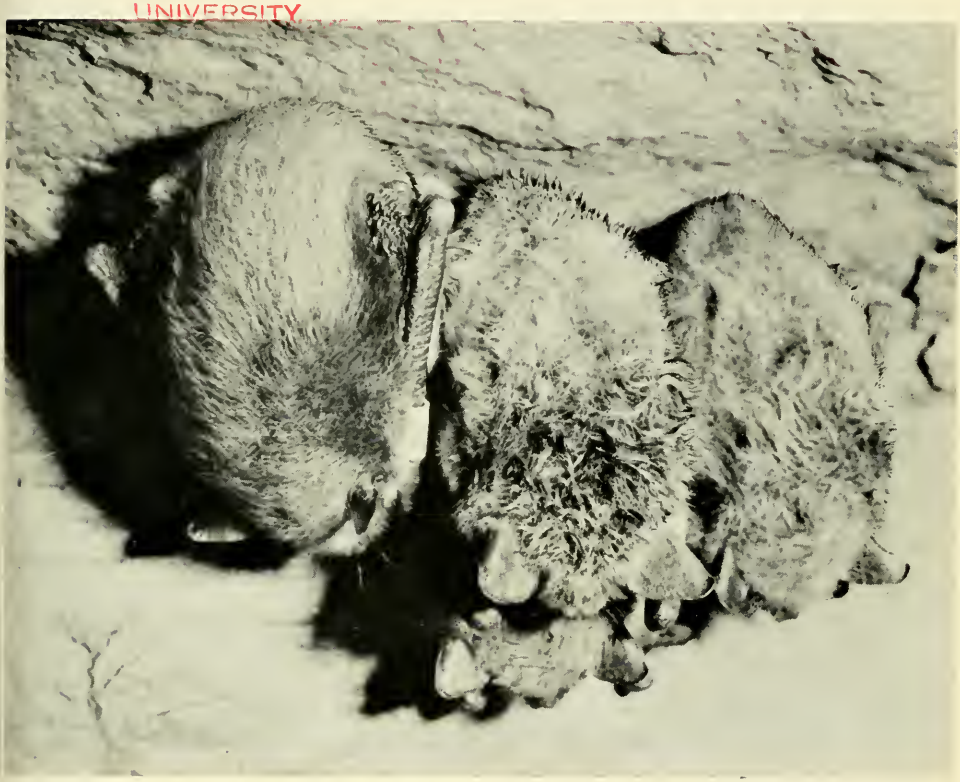
The Distributional Status of Bats in Kansas



J. KNOX JONES, JR.
EUGENE D. FLEHARTY
PATRICK B. DUNNIGAN

The University of Kansas Museum of Natural History

ILLUSTRATION ON FRONT COVER

Hibernating *Myotis lucifugus lucifugus* in abandoned gypsum mine in Marshall County, Kansas. Note banded individual in foreground. Photograph by James D. Smith, March 3, 1963.

The Distributional Status of Bats in Kansas

BY

J. Knox Jones, Jr., Eugene D. Fleharty, and Patrick B. Dunnigan

MUSEUM OF NATURAL HISTORY
The University of Kansas

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Bats have been the subject of increased interest and study in the United States in recent years owing primarily to their intriguing, and in many ways unique, biological properties, but also because some species have been associated with diseases affecting man (six bats were diagnosed as being positive for rabies in Kansas in 1965), and because some kinds are economically beneficial. In 1960, one of us (Jones) initiated investigations at The University of Kansas designed to increase our knowledge of these mammals in the state. Independently, Fleharty began work in the same direction in 1962 at Ft. Hays Kansas State College. Some results of these research efforts already have been published (Fitch, 1966; Fleharty and Farney, 1965; Jones and Downhower, 1963; Phillips, 1966; Ubelaker, 1966); other studies are in progress. This paper summarizes new information, and integrates it with that already available in published form, on the geographic and seasonal distribution of bats in Kansas. Thus the following account is a progress report on one phase of current studies of Kansas bats.

Cockrum's (1952) section on bats in his "Mammals of Kansas" is the most recent publication in which the distribution of bats in the state was treated in detail. Hall (1955) up-dated some of Cockrum's distribution maps and added one species that had been reported in the years that elapsed between the two publications. Cockrum treated 13 species of chiropterans and examined a total of 651 specimens. Our present report lists 15 species from the state and is based on study of 1,646 specimens. It is hoped that this summary will stimulate other biologists in Kansas to record their findings.

In connection with this report, it seems appropriate to note that approximately 8,000 bats of eight different species have been banded (on the forearm, with numbered aluminum bands) in Kansas in the past six years. Thousands more have been banded by us and other workers in adjacent states. From these, and those that will be banded in the future, it is hoped to learn considerably more than presently is known about such things as movements and longivity of bats in this region. Persons finding banded bats are

encouraged to *read the band number carefully* and, if at all possible, to *release the bat unharmed.* Band numbers should be reported immediately to the Bird and Mammal Laboratories, U. S. Fish and Wildlife Service, U. S. National Museum, Washington, D. C., 20560, along with indication of exact date and place captured. If a banded bat is inadvertantly killed, this fact also should be reported. All bat bands carry a *two-digit or three-digit code number* above a *five-digit band number.* Sample numbers that have been used in Kansas are 59 [upper number] -43095 [lower number] and 662-22101.

Much remains to be learned about the distribution of bats in Kansas. Interested persons are encouraged to communicate with the Museum of Natural History, The University of Kansas, Lawrence, 66044, or the Division of Biological Sciences, Ft. Hays Kansas State College, Hays, 67602, and to send specimens for study. Bats may be preserved most easily for identification by immersing them in formalin (U. S. P. 40 per cent, available at most drug counters) that is to be diluted by the user: nine parts of water to one part of formalin. In order to prevent decay of the viscera, the abdomen should be injected with preservative by means of a syringe or else a slit three-quarters of an inch long should be made in the abdomen so as to allow preservative to enter the abdominal cavity. After prepared and immersed in formalin for at least 24 hours, specimens may be sealed in a plastic bag along with a piece of cotton, absorbent cloth, or paper toweling that is soaked with preservative, and packed in a sturdy container for shipment.

EXPLANATION AND ACKNOWLEDGMENTS

In the accounts that follow, we have attempted to summarize the distributional status of each of the 15 species known from Kansas. A key to bats occurring in the state and a list of other species that one day may be found are appended. On distribution maps, the shaded area is our estimate of the probable distribution in Kansas of the species concerned; if no shading is used anywhere on the map, the species is to be expected (in suitable habitats) in any part of the state. In preparing maps we took account of specimens reported from adjacent states, especially those listed by Glass and Ward (1959) for Oklahoma and by Jones (1964) for Nebraska. In lists of specimens examined and records cited from other sources, localities in italic type are not plotted on the maps because symbols would have been unduly crowded. For the same reason, some localities that are plotted are slightly offset on the maps.

In checking distributional records, we found that some localities have been incorrectly located in earlier published reports. Several of these are

discussed in text; others can be recognized in the sections entitled "specimens examined" or "other records" because the name of an earlier-reported locality is followed in brackets by our best estimate of its exact location.

Of the three authors, Jones and Fleharty are responsible for preparing the accounts herein, whereas Dunnigan did much of the earlier work of accumulating and checking records as well as participating in field studies. We are grateful to a number of students, past and present, for assisting with various phases of field work. Of these, we would mention especially John H. Fitch, G. Lawrence Forman, and William C. Stanley of The University of Kansas and John P. Farney and Kenneth W. Andersen of Ft. Hays State College.

Some persons at other schools in the state have been most helpful in supplying specimens and band records, or both; we are especially mindful of the contributions of Horace A. Hays and Everett Grigsby of Pittsburg State College and Stanley Roth of Lawrence High School. Bryan P. Glass and associates, Alfred Perry and George Rogers, of Oklahoma State University graciously provided us with records of bats banded by them in northern Oklahoma that later were recovered in Kansas. A grant (3873-5038) from The University of Kansas General Research Fund helped to defray costs of field and laboratory studies.

Finally we are grateful to those persons in charge of the collections at the following institutions (abbreviations used in the accounts of species are in parentheses) for allowing us to examine specimens in their care: Emporia (Kansas) State College (ESC); Field Museum of Natural History (FMNH); Kansas State University, Manhattan (KSU); Pittsburg (Kansas) State College (PSC); U. S. National Museum (USNM). Specimens examined in the collection of the Museum of Natural History, The University of Kansas, carry no designation as to institutional source. Those in the museum at Ft. Hays State College are designated by the abbreviation FHSC.

ACCOUNTS OF SPECIES

Family VESPERTILIONIDAE

Myotis grisescens A. H. Howell, 1909

Gray Myotis

Distribution in Kansas.—Known only from extreme southeastern part of state (see Fig. 1).

The gray myotis first was reported from Kansas by Long (1961) on the basis of a juvenal male taken "in a residential area" in Pittsburg in the summer of 1958. Later, Jones and Downhower (1963) recorded an October-taken specimen from Cherokee County and Hays and Bingman (1964) reported the finding in 1961 of a colony of *M. grisescens* in a large storm sewer in Pittsburg.

Since the Pittsburg colony was discovered it has been studied both by H. A. Hays and his students at Pittsburg State College and by us and our associates (see Ubelaker, 1966, for example). Suffice it to report at this time that approximately 2000 gray myotis inhabit

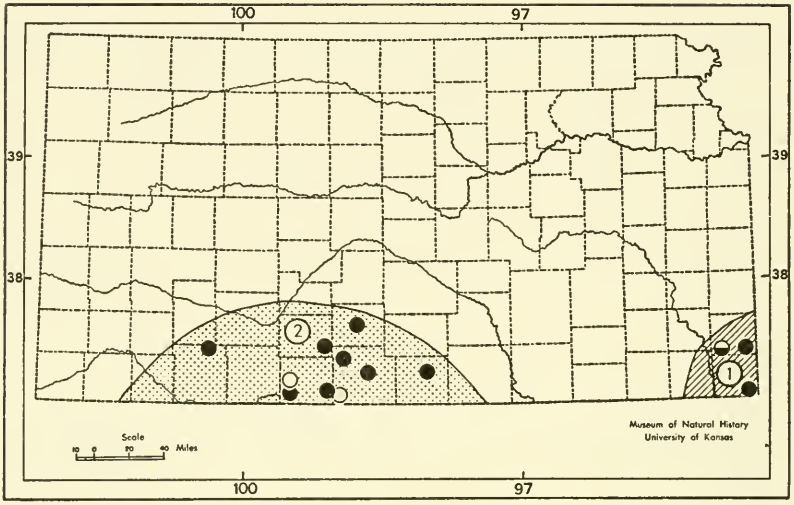

FIG. 1. Distribution of *Myotis grisescens* (1) and *Myotis velifer incautus* (2) in Kansas. On maps 1-11, solid symbols represent specimens examined, open symbols represent records from the literature, half-shaded symbols represent band records, circles represent exact localities, and triangles represent records known only to county.

the sewer in summer, including both males and a maternity colony of females. Most of these bats migrate in October and November to winter quarters in caves about 100 miles to the east in southern Missouri (Camden, Laclede, and Stone counties judging from banded bats thus far recovered), but a few, usually less than 50, remain in the sewer all winter. Some females may migrate earlier in autumn than do males. Of 309 bats banded on November 1, 1964 (taken from an estimated 1500 in the sewer at that time), 239 were males and only 70 were females. In spring, most of the bats that will form the summer colony have returned to Pittsburg by the middle of April.

To date, recoveries of banded individuals of *M. grisescens* in Kansas, save for those found in the sewer and its immediate vicinity in Pittsburg, have added only two localities in Crawford County (see list beyond) to the known distribution of this bat in the state.

Specimens examined (58).—CHEROKEE COUNTY: 1 mi. S Galena, 1. CRAWFORD COUNTY: Pittsburg, 57 (15 PSC).

Other records.—CRAWFORD COUNTY: Lightning Creek, 15½ mi. W Pittsburg (band record); *3 mi. W Quincy and Broadway streets, Pittsburg* (band record).

Myotis keenii septentrionalis (Trouessart, 1897)

Keen's Myotis

Distribution in Kansas.—Known only from Marshall and Washington counties in the east and from Ellis and Rooks counties in the west (see Fig. 2).

Considering its potential distribution in the state, less is known about the range of *Myotis keenii* than about that of any other resident bat. The species first was reported from Kansas by Jones *et al.* (1952) on the basis of four hibernating individuals collected on December 29, 1951, in an abandoned gypsum mine in southwestern Marshall County, although Hibbard (1933) had predicted its occurrence nearly two decades earlier. Since the initial report, this bat has been found at six other localities, all in the past two years.

Keen's myotis is the most abundant of the three species of bats (the others are *Myotis lucifugus* and *Pipistrellus subflavus*) that occur in the Marshall County mine. Slightly more than 1,000 individuals of *keenii* have been banded there since the autumn of 1962. The bats hiberate in the mine in winter but quit it in spring. Males and a few (probably barren) females stay in the immediate vicinity in spring and summer and can be netted at the mine entrance at night, but few if any evidently roost there in daytime.

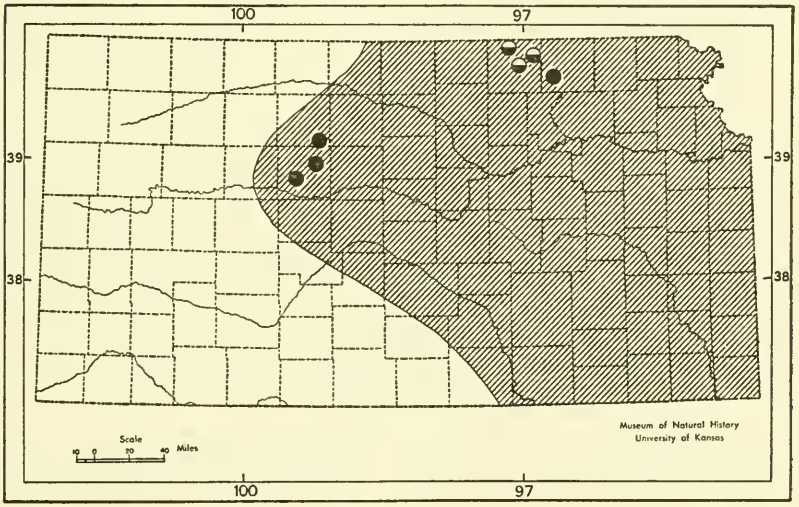

FIG. 2. Distribution of *Myotis keenii septentrionalis* in Kansas. See Fig. 1 for explanation of symbols.

Most females leave the area in spring—probably forming maternity colonies, at places yet unknown—but return in August and early September.

Thus far, only three bats banded at the mine in Marshall County have been recovered elsewhere, all in adjacent Washington County. Two of these (male and female) were banded on August 23, 1965; the male was recovered at Hanover on September 28, 1965, and the female was found 11 mi. N Morrowville on October 20 of the same year. A female, originally banded on March 3, 1963, was killed in a house in Washington on March 26, 1964. All of these recoveries are northwest of the mine and the dates suggest that the bats were moving to, or returning from, some other concentration(s). However, we currently have no record of colonies (or even other localities of occurrence) in that direction in Kansas or in adjacent Nebraska.

Myotis keenii first was reported from western Kansas by Fleharty and Farney (1965) on the basis of three females taken at Hays in 1964—one on July 31 and the others in late September. In the following April and May, six females and one male were collected from various buildings on the Ft. Hays State College campus. On April 1, 1965, three males were obtained in a semi-torpid state from a small cave in Rooks County. The following day, four bats (two of each sex) were found in a crevice in a small limestone cave in northeastern Ellis County where several other *keenii* were present but not disturbed. All these bats were torpid and probably still in hibernation. The cave in Ellis County evidently is used only as a hibernaculum as it was vacant in early June, 1966. No other species of bats were found in either of the mentioned caves.

No Keen's myotis were taken in the autumn of 1965 at Hays, but in the spring of 1966 a male and female were found on the exteriors of campus buildings on April 12 and 25, respectively. The animals collected at Hays indicate seasonal movement through this area, but we presently have no information as to the origin or destination of the bats. Temperatures of the few potential hibernacula may be one of the most important factors limiting the distribution of this species in the state (Fitch, 1966).

Specimens examined (80).—ELLIS COUNTY: Hays, 12 (FHSC); SE ¼ sec. 31, R. 16 W, T. 11 S, 4 (FHSC). MARSHALL COUNTY: ¼-½ mi. N, 1½ mi. W Blue Rapids, 61 (40 FHSC). ROOKS COUNTY: 3 mi. S, 1 mi. E Codell, 3 (FHSC).

Other records.—WASHINGTON COUNTY: 11 mi. N Morrowville (band record); Hanover (band record); Washington (band record).

Myotis leibii ciliolabrum (Merriam, 1886)

Small-footed Myotis

Distribution in Kansas.—Probably occurs in suitable habitats in western third of state; presently known only from Gove, Logan, and Trego counties (see Fig. 3).

Judging from the available evidence, *Myotis leibii* is one of the rarest of the resident bats in Kansas, although this situation may result, at least in part, from a paucity of zoological exploration in certain areas where the species is likely to be found. At any rate, only 27 specimens have thus far been collected, all from the areas of chalk bluffs and canyons and erosional Miocene rocks in extreme western Trego, Gove, and eastern Logan counties.

In August of 1884, A. B. Baker collected seven specimens in the immediate vicinity of the former hamlet of Banner, in western Trego County. Of these, two were found in "bluffs or cañons" near the town. "The others were captured at a bluff several miles distant. They had secreted themselves in abandoned swallows' nests which were inaccessible; but the bats were easily dislodged by means of stones" (Merriam, 1886:2). In 1926 and 1927, field parties from the Museum of Natural History took seven specimens in the vicinity of Castle Rock in July and August and six specimens in August at a place 5 mi. W Elkader, Logan County. The most recently obtained specimens were taken in western Gove County in 1966—a

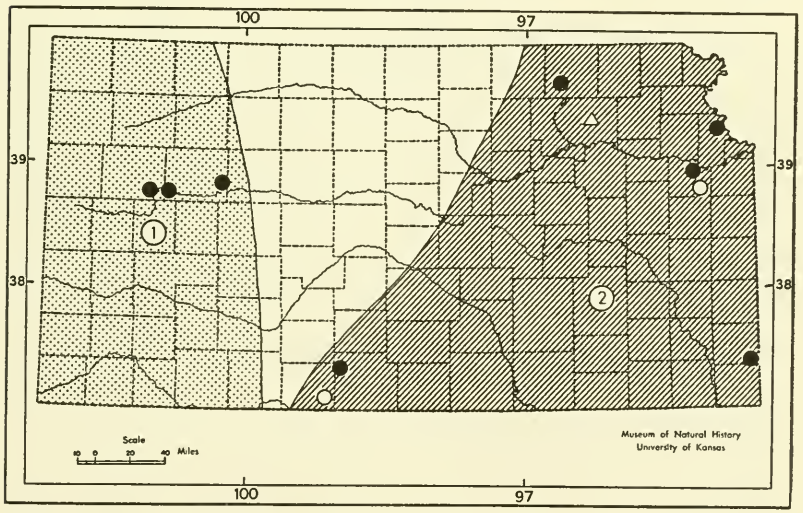

FIG. 3. Distribution of *Myotis leibii ciliolabrum* (1) and *Myotis lucifugus lucifugus* (2) in Kansas. See Fig. 1 for explanation of symbols.

male and non-pregnant female that were shot on May 4, the former as it flew at dusk at Monument Rock and the latter in a barn a mile south of that place, and two males captured on September 5 as they roosted singly in shallow crevices at Monument Rock.

The mentioned specimens from Castle Rock are labeled as having been collected in Trego County and have been thus reported several times in the literature (see Cockrum, 1952:63, for example). Castle Rock, however, is in Gove County, approximately a mile west of the Trego County line. Information on the specimen labels and in the available field notes indicates that the collectors actually were at Castle Rock or in the canyons just south of Castle Rock. The absence of any information that these bats were taken to the east of Castle Rock prompts us to list them from Gove County.

A second subspecies, *Myotis leibii leibii* (Audubon and Bachman, 1842), of this species may occur in Kansas. *M. l. leibii,* which is darker and somewhat larger than *ciliolabrum,* has been reported from central Missouri and eventually may be found in the southeastern part of the state. We tentatively follow Glass and Baker (1965:204-205) in use of the specific name *leibii,* rather than *subulatus,* for this bat.

Specimens examined (27).—GOVE COUNTY: Castle Rock, 6 (1 USNM); *near Castle Rock,* 1; *S of Castle Rock,* 1; Monument Rock, 3 (2 FHSC); *1 mi. S Monument Rock,* 1. LOGAN COUNTY: 5 mi. W Elkader, 7 (1 USNM); *"chalk bluffs near Elkader,"* 1 (ESC). TREGO COUNTY: [near] Banner, 7 (USNM).

Myotis lucifugus lucifugus (Le Conte, 1831)

Little Brown Myotis

Distribution in Kansas.—Eastern part of state, west certainly to Marshall and Comanche counties (see Fig. 3).

This species is known from several localities in eastern Kansas, but is nowhere common save at an abandoned gypsum mine in Marshall County where more than half of the specimens we have examined were collected and where approximately 400 individuals have been banded since the winter of 1962-63. In this mine, described by Fitch (1966), *M. lucifugus* occurs in approximately equal numbers with *Pipistrellus subflavus;* both of these species are outnumbered there by *Myotis keenii,* the only other bat known to inhabit the mine. In summer, *lucifugus* abandons the mine as a daytime retreat but at least some individuals remain in the immediate vicinity and can be netted at the entrance at night. Both sexes are present throughout the year, but males normally out-

number females in our samples. We have no returns for *lucifugus* that have been banded in Marshall County except at the mine itself and, therefore, have no indication as to dispersal in summer of the bats that winter there.

Elsewhere in Kansas, *M. lucifugus* is known from but a handful of specimens. Some of these were obtained in caves, abandoned mines, and storm sewers in hibernation. Summer-taken individuals on record (aside from those banded in Marshall County) are seven from Lawrence that were obtained in July (two), August (four), and September (one), a September-taken male from Havard Cave, Barber County, and six individuals from Pittsburg (two collected and three banded in August and one obtained in early September).

A second subspecies, *Myotis lucifugus carissima* Thomas, 1904, of the little brown myotis possibly will be found in Kansas. It has been reported from Colorado and western Nebraska.

Specimens examined (49).—BARBER COUNTY: Havard Cave [2½ mi. SW Sun City], 1. CRAWFORD COUNTY: Pittsburg, 4 (2 PSC). DOUGLAS COUNTY: Lawrence, 7. LEAVENWORTH COUNTY: Leavenworth, 3; *1 mi. SE Leavenworth*, 1. MARSHALL COUNTY: ¼-½ mi. N, 1½ mi. W Blue Rapids, 33 (15 FHSC, 1 KSU).

Other records.—COMANCHE COUNTY: Double-entrance "S" Cave (Hibbard, 1934b:236). DOUGLAS COUNTY: Baldwin (Kellogg, MS). LEAVENWORTH COUNTY: *Ft. Leavenworth* (Brumwell, 1951:209). POTTAWATOMIE COUNTY: no specific locality (Cockrum, 1952:58).

Myotis velifer incautus (J. A. Allen, 1896)

Cave Myotis

Distribution in Kansas.—South-central part of state (see Fig. 1).

Although this cave bat occupies a relatively small area in Kansas, it is the most abundant species of the genus *Myotis* in the state. Fitch and Dunnigan (MS, in press, Trans. Kansas Acad. Sci., 1967) estimated that between 50,000 and 75,000 individuals inhabit the gypsum caves and adjacent areas in Barber and Comanche counties. Present evidence suggests that there are two main populations of *M. velifer* in this area—one centered around Sun City in northwestern Barber County, and the other centered in southeastern Comanche County and adjacent parts of southwestern Barber County and Woods County, Oklahoma. The National Gypsum Mine, 2 mi. S, 1¼ mi. W Sun City, serves as the major hibernaculum for the northern population; bats disperse in spring from this mine to adjacent caves and to man-made structures to the north of the mine. Double-entrance "S" Cave, 11½ mi. S, 16 mi. E Coldwater, evidently is the major hibernaculum for the southern segment. Bats from this cave

migrate as far away as northern Meade County in summer. Information available from banded bats indicates only occasional interchange of individuals between the two populations.

Lantz (1918:241) was the first to report *Myotis velifer* from Kansas. Hibbard (1934b) and Twente (1955a, 1955b) have made noteworthy ecological observations on this species in Kansas.

[A female cave myotis captured on October 1, 1966, after this account was prepared, in NE ¼ sec. 1, R. 14 W, T. 24 S, Stafford County, provides the northernmost locality of record for the species in Kansas. This bat was banded at the National Gypsum Mine in Barber County on December 21, 1964.]

Specimens examined (225).—BARBER COUNTY: Sun City, 13 (4 KSU, 9 USNM); *National Gypsum Mine* [*2 mi. S, 1¼ mi. W Sun City*], 5 (KSU); *Havard Cave* [*2½ mi. SW Sun City*], 81 (1 KSU); *cave 4 mi. SSE Sun City,* 2 (USNM); *4-5 mi. S Sun City,* 38 (1 ESC, 27 FHSC); *4¾ mi. S, ½ mi. E Sun City,* 2; Medicine Lodge, 1 (USNM); *no specific locality,* 2 (KSU). COMANCHE COUNTY: 10 mi. S Protection, 3; Swartz Canyon, 9 mi. S, 14 mi. E Coldwater, 16; *Swartz Canyon, 8 mi. SW Aetna,* 1; *Double-entrance "S" Cave* [*11½ mi. S, 16 mi. E Coldwater*], 14; *12 mi. S, 14 mi. E Coldwater,* 1 (FHSC); *14 mi. S, 17 mi. E Coldwater,* 3 (FHSC); *S end Swartz Canyon, sec. 16, R. 34 W, T. 35* S, 21 (FHSC). HARPER COUNTY: Harper, 7; *no specific locality* [*probably Harper*], 4. KIOWA COUNTY: 4 mi. N Belvidere, 3. MEADE COUNTY: 5 mi. N, 6 mi. W Fowler, 6. PRATT COUNTY: Pratt, 2.

Other records.—BARBER COUNTY: *Dancer's Cave, 4½ mi. S Sun City* (band record); *Natural Bridge* [*4½ mi. S, ¼ mi. E Sun City*] (Hibbard, 1934b: 235); Aetna (Twente, 1955b:712); *3½ mi. S, 1 mi. W Aetna* (Cockrum, 1952:60); *4 mi. S Aetna* (Loomis, 1956:1242); *May Cave* and *Lost Colony Cave* (Twente, 1955a:381). COMANCHE COUNTY: near Protection (Cockrum, 1952:60).

Lasionycteris noctivagans (Le Conte, 1831)

Silver-haired Bat

Distribution in Kansas.—Probably state-wide during seasonal migrations, but evidently not resident in Kansas (see Fig. 4).

This migratory bat is found in Kansas and adjoining parts of adjacent states only in spring and again in late summer and early autumn. It is a summer resident at higher latitudes and altitudes to the north and west of the state and presumably spends the winter mostly to the south of Kansas (although there are records of hibernating individuals from some places in the northern part of the range of the species).

All but two of the localities where this bat has been taken in Kansas are in the western, less populous areas of the state rather than in the eastern part, where more frequent contact between humans and migrating bats might be expected. Possibly this indicates that western Kansas is on one of the principal migratory

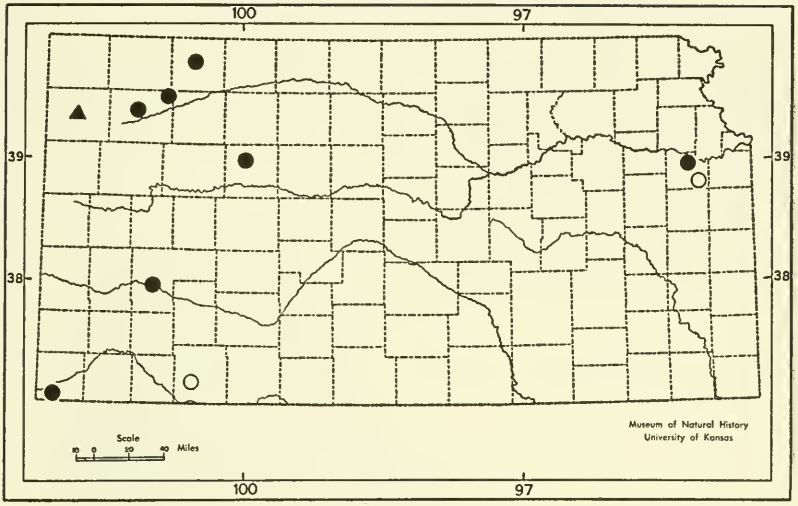

FIG. 4. Distribution of *Lasionycteris noctivagans* in Kansas. See Fig. 1 for explanation of symbols.

routes. All records from the state for which a date of capture is known are from the period September 12 to October 15, excepting two non-pregnant females, from Thomas and Trego counties, taken in May of 1966. At Meade County State Park two specimens were found in June, 1959, in mouse traps that had been set, baited with raisins, in closets of a building in late August of the previous year (Getz, 1961:282). The dried condition of the bats indicated they had been trapped in the previous autumn.

Specimens examined (11).—DECATUR COUNTY: Oberlin, 1. DOUGLAS COUNTY: Lawrence, 1. FINNEY COUNTY: Garden City, 1. MORTON COUNTY: *1 mi. W Elkhart*, 1; Elkhart, 3. SHERMAN COUNTY: no specific locality, 1 (USNM). THOMAS COUNTY: 3½ mi. N Rexford, 1 (FHSC); Colby, 1 (FHSC). TREGO COUNTY: Wakeeney, 1 (FHSC).

Other records.—DOUGLAS COUNTY: Baldwin (Kellogg, MS). MEADE COUNTY: Meade County State Park (Getz, 1961:282). TREGO COUNTY: *vicinity Wakeeney* (A. B. Baker, 1889:57).

Pipistrellus subflavus subflavus (F. Cuvier, 1832)

Eastern Pipistrelle

Distribution in Kansas.—Eastern part of state, west certainly to Marshall County in the north and to Barber County in the south (see Fig. 5).

When Cockrum (1952:66-68) wrote about this species in Kansas, he had examined only 20 specimens from the state. Many addi-

tional specimens have been collected since then and, in fact, this species has been found to be relatively common in suitable places in the eastern part of the state. Nonetheless, even though it is now known from 12 rather than five counties, the area of estimated distribution in Kansas has been increased but little in the past 16 years (compare Fig. 5 with Cockrum's, 1952:66, distribution map).

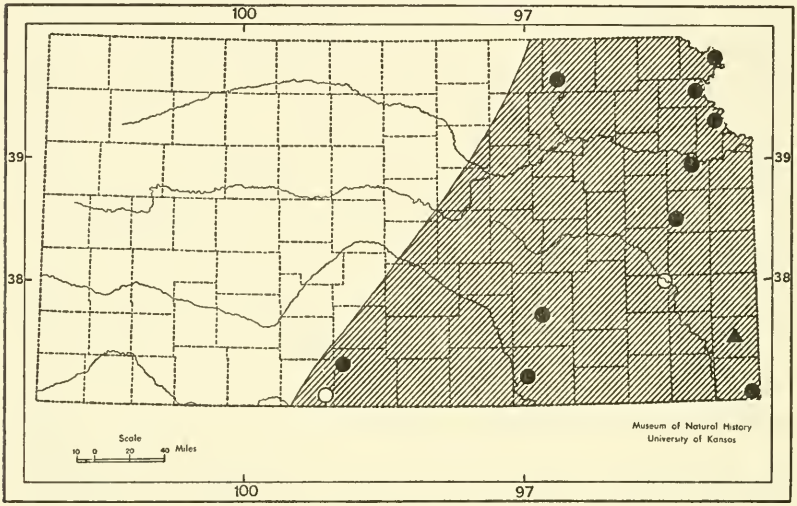

Fig. 5. Distribution of *Pipistrellus subflavus subflavus* in Kansas. See Fig. 1 for explanation of symbols.

Actually, the eastern pipistrelle is best known in Kansas in winter, when individuals hibernate in humid caves and abandoned mines, often in limestone. In our experience, they hang singly on walls or ceilings of hibernacula, in exposed places, and frequently have droplets of water on the pelage. *Myotis keenii, Myotis lucifugus,* and *Eptesicus fuscus* inhabit some of the same hibernacula as does *P. subflavus* in eastern Kansas, whereas *Myotis velifer* and *Plecotus townsendii* hibernate along with the eastern pipistrelle in the caves of Barber County. The largest known concentration of pipistrelles in the state is in an abandoned gypsum mine in Marshall County, where more than 400 have been banded since the winter of 1962-63. In the warm months these bats evidently do not seek daytime retreats in this mine (or, for that matter, in other hibernacula) but reside someplace in the immediate vicinity because individuals (mostly males) have been netted at the entrance of the mine as they attempted to enter at night.

Other abandoned mines, caves, or sinks in which pipistrelles are

known to hibernate in Kansas yield but a few individuals at any one time.

Specimens examined (122).—ATCHISON COUNTY: 2 mi. S, ¾ mi. E Courthouse, Atchison, 1; *NE ¼ sec. 19, R. 21 E, T. 6 S*, 1. BARBER COUNTY: Havard Cave [2½ mi. SW Sun City], 6 (1 KSU); *4 mi. SSE Sun City*, 1 (USNM); *4-5 mi. S Sun City* (*labeled with reference to Dancer's Cave, Gyp Spring, or Sinkhole Cave*), 5. BUTLER COUNTY: 5-6 mi. S El Dorado, 9. CHEROKEE COUNTY: 1-1½ mi. S Galena, 12. CRAWFORD COUNTY: no specific locality, 1 (PSC). COWLEY COUNTY: 1 mi. W Winfield, 9; *1 mi. E Winfield*, 1. DONIPHAN COUNTY: 5 mi. N, ½ mi. E Wathena, 4. DOUGLAS COUNTY: Lawrence, 1. FRANKLIN COUNTY: 2½-3 mi. N, ¾ mi. E Williamsburg, 5. LEAVENWORTH COUNTY: Ft. Leavenworth, 2; *1 mi. SE Leavenworth*, 1. MARSHALL COUNTY: ¼-½ mi. N, 1½ mi. W Blue Rapids, 64 (42 FHSC, 1 KSU).

Other records. — COMANCHE COUNTY: Double-entrance "S" Cave (Twente, 1955b:708). WOODSON COUNTY: Neosho Falls (Cragin, 1885:47).

Eptesicus fuscus

Big Brown Bat

This species is the most abundant and widespread of Kansas bats. In winter individuals hibernate in large caves, abandoned mines or quarries, storm sewers, and buildings. Females form maternity colonies in spring, normally in places other than hibernacula although we know of two wooden structures in central Kansas that serve both as hibernacula and maternity quarters. Males and barren females may disperse from hibernacula in spring, but

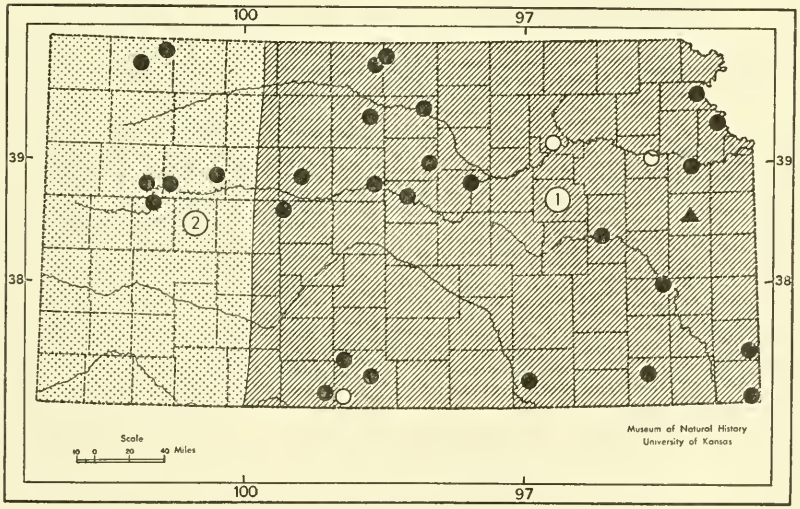

FIG. 6. Distribution of *Eptesicus fuscus fuscus* (1) and *Eptesicus fuscus pallidus* (2) in Kansas. See Fig. 1 for explanation of symbols.

remain in the immediate vicinity; some, however, utilize the same area the year around. Such is the case in the abandoned limestone quarry at the southeast edge of Leavenworth discussed by Phillips (1966:180).

Nine of the individuals (eight males and one female) banded at the Leavenworth quarry have been recovered elsewhere. All nine were from within three and a half miles of the quarry. The longest distance traveled by any *Eptesicus* banded by us in Kansas was approximately 45 miles. The bat was a male banded in hibernation in Lawrence on January 8, 1965, and captured the following April in Kansas City, Missouri.

Two subspecies of *Eptesicus fuscus* occur in Kansas, *E. f. fuscus* in the east and *E. f. pallidus* in the west. Our studies of available specimens lead us to suggest that the boundary between these two races lies some 100 miles westward from where it was drawn by Cockrum (1952:69). Evidently, Cockrum took bats from western Kansas to be typical of *pallidus* (see also Black, 1938:150). Actually, specimens from western Kansas that we have examined are intergrades between *fuscus* and *pallidus,* although assignable to the latter. A graduate student at The University of Kansas, James A. Howard, is studying geographic variation in this species in Kansas and adjacent states; his findings may alter our tentative conclusions as expressed in the lists of specimens beyond and Fig. 6.

Eptesicus fuscus fuscus (Palisot de Beauvois, 1796)

Distribution in Kansas.—Eastern two-thirds of state, west to Comanche, Ellis, and Rush counties (see Fig. 6).

Specimens examined (390).—ATCHISON COUNTY: Atchison, 4; *NE ¼ sec. 19, R. 21 E, T. 6 S,* 1; *2 mi. S, ¾ mi. E Atchison County Courthouse,* 13. BARBER COUNTY: Sun City, 1 (KSU); *Havard Cave* [*2½ mi. SW Sun City*], 1 (KSU); Medicine Lodge, 46. CHEROKEE COUNTY: 1 mi. S, 1 mi. E Galena, 3. COMANCHE COUNTY: Double-entrance "S" Cave, 4. COWLEY COUNTY: Winfield, 3 (1 FMNH, 2 USNM). CRAWFORD COUNTY: Pittsburg, 13 (PSC). DOUGLAS COUNTY: Lawrence, 41; *1 mi. N, 1 mi. W Lawrence,* 1; *no specific locality,* 6. ELLIS COUNTY: Hays, 58 (42 FHSC). ELLSWORTH COUNTY: Ellsworth, 17. FRANKLIN COUNTY: no specific locality, 1. JEWELL COUNTY: 7 mi. N, 3 mi. E Lebanon, 20. LEAVENWORTH COUNTY: *Ft. Leavenworth,* 9; Leavenworth, 78; *½-1 mi. SE Leavenworth,* 6. LINCOLN COUNTY: Beverly, 13. LYON COUNTY: Emporia, 7 (2 ESC). MITCHELL COUNTY: Beloit, 1. MONTGOMERY COUNTY: Independence, 1. OSBORNE COUNTY: Osborne, 13. RUSH COUNTY: McCracken, 1 (FHSC). RUSSELL COUNTY: Dorrance, 22. SALINE COUNTY: Salina, 3 (ESC). SMITH COUNTY: Lebanon, 1. WOODSON COUNTY: Neosho Falls, 2 (USNM).

Other records.—BARBER COUNTY (Twente, 1955b:712, 724): *National Gypsum Mine* [*2 mi. S, 1¼ mi. W Sun City*]; *Natural Bridge* [*4½ mi. S, ¼ mi. E Sun City*]; Aetna; *May Cave.* COWLEY COUNTY: *½ mi. S, ½*

mi. W Winfield (band record). LEAVENWORTH COUNTY: *Wadsworth* (band record). RILEY COUNTY: *Manhattan* (Cragin, 1885:46); Ft. Riley (Allen, 1894:121). SHAWNEE COUNTY: Topeka (Cragin, 1885:46).

Eptesicus fuscus pallidus Young, 1908

Distribution in Kansas.—Western third of state (see Fig. 6).

Specimens examined (140).—GOVE COUNTY: Castle Rock, 21; *"Old Smoky Pyramids,"* 2 (KSU); Monument Rock, 2; *1 mi. S Monument Rock*, 4. LOGAN COUNTY: 5 mi. W Elkader, 37; *Elkader*, 6 (FHSC). RAWLINS COUNTY: Herndon, 22; Atwood, 19. SCOTT COUNTY: 10 mi. N, ¼ mi. W Scott City, 26 (8 FHSC); *Scott County State Park*, 1.

Lasiurus borealis borealis (Müller, 1776)

Red Bat

Distribution in Kansas.—Migrant; probably state-wide in suitable habitats and seasons (see Fig. 7).

The red bat is known in Kansas and adjacent states only in the warm months. Adults of both sexes (but predominately females) migrate to the state in spring and return southward in late summer or early autumn. Much remains to be learned about the migratory habits and winter range of this bat; individuals have been reported in recent years as over-wintering in Illinois and it is not inconceivable that some may do so in Kansas. The earliest spring record for the state is of a female taken on March 18, 1963, in Pittsburg although individuals evidently do not reach the northern part of Kansas until the latter part of April (earliest records are April 21, 1961, from Emporia, and April 26, 1950, from Lawrence). The latest record in autumn is of a female, presumably a migrant, that struck a TV tower in Shawnee County on the night of October 15-16, 1957 (Janes, 1959:263).

Lasiurus borealis characteristically roosts in trees or tall bushes by day and is one of the commonest bats in eastern Kansas from May through July. We have rarely seen red bats after mid-August in Lawrence. In the western half of the state, this species evidently is rare, of sporadic occurrence, and limited in distribution to stands of deciduous timber along water courses and in towns and cities. One of us (Fleharty) searched unsuccessfully for red bats in Hays for three consecutive summers. The first specimens from there, seven in all (a female accompanied by four offspring and two other isolated immature individuals) were obtained in June and July of 1966.

We had always assumed that adults of both sexes occurred in about equal abundance in Kansas but a tabulation of adults ex-

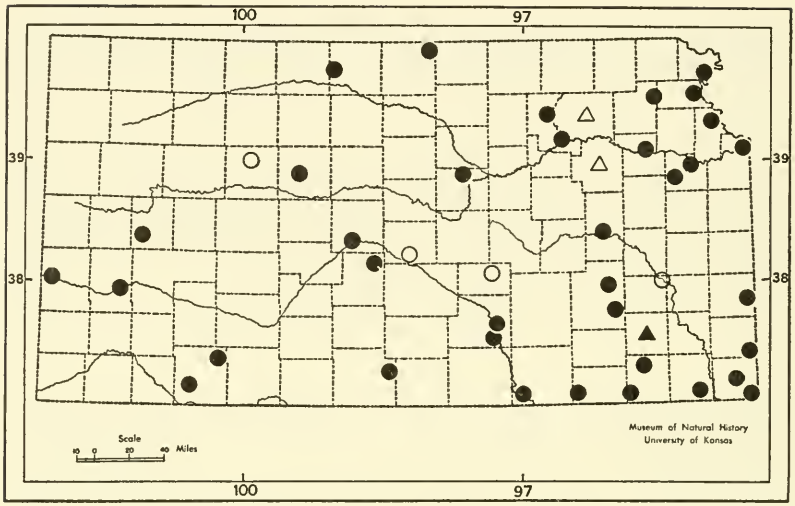

FIG. 7. Distribution of *Lasiurus borealis borealis* in Kansas. See Fig. 1 for explanation of symbols.

amined by us (young of the year are excluded) from the state indicates that females far outnumber males in our sample.

Month	Males	Females
March	0	1
April	0	5
May	5	11
June	2	54
July	6	29
August	3	10
September	4	1
October	1	0

Three possible explanations to account for the preponderance of females are: 1) many more females than males normally occur in populations of this species, on account of imbalance in sex ratios at birth, for example; 2) sampling techniques are weighted heavily in favor of capture of females; or 3) males ordinarily spend the warm months in places other than Kansas and adjacent areas. The first possibility can be discarded because the numbers of males and females in 18 Kansas litters of red bats for which the sex is known for all offspring do not differ significantly and because no evidence to substantiate a larger number of female young has been published elsewhere. It is conceivable, of course, that differential mortality or longevity, or both, favor females but we doubt it.

The second possibility may be a partial factor in that a roosting female accompanied by young likely would be more conspicuous

than a solitary male and thus more liable to detection and collection and, furthermore, females with young clinging to them occasionally fall to the ground as a result of being dislodged from their roost by strong winds, heavy rain or hail, or for some other reason. Our collections, like others in this region, are sprinkled with females and their young that were captured on the ground. Nevertheless, collections of red bats gathered by more conventional means—shooting and netting—also consist mostly of females. For example, 15 of 16 adult bats shot as they foraged over water in May, June, and July in three different years (1964-66) at The University of Kansas Fisheries Laboratory in Lawrence were females.

The evidence strongly suggests, therefore, that males are uncommon in Kansas in spring and early summer. Our limited data indicate that their numbers approximate those of females in late summer and early autumn but this could result, at least in part, from an influx of migrants (of six individuals, presumably migrants, that struck the same TV tower in Shawnee County between September 23 and October 16 in three different years, three were males and three were females). Evaluation of information available from other central plains states indicates that females also are more numerous there in summer. Additional data on distribution of adults from throughout the warm-weather range of *L. borealis* are needed to test our tentative conclusions.

Females, pregnant prior to beginning northward migration in spring, bear young in Kansas late in May and in June. Twenty-nine pregnant individuals taken in May and June carried an average of 3.24 (2-4) embryos; 27 females (June and July) were accompanied by an average of 2.96 (2-4) young. The youngest flying young of the year among our specimens was taken on June 30, 1944, in Hamilton County.

Specimens examined (286).—ATCHISON COUNTY: 2 mi. S, ¾ mi. E Atchison County Courthouse, 2. BARBER COUNTY: 2 mi. N, 1 mi. E Sharon, 1. BARTON COUNTY: Great Bend, 1 (FHSC). BOURBON COUNTY: Ft. Scott, 5. CHAUTAUQUA COUNTY: Cedar Vale, 1 (USNM). CHEROKEE COUNTY: Columbus, 2 (PSC); ½ mi. S Galena, 1; *no specific locality,* 1. COWLEY COUNTY: Arkansas City, 2. CRAWFORD COUNTY: *1 mi. N Crawford County State Park,* 1 (PSC); Pittsburg, 7 (PSC). DONIPHAN COUNTY: *Doniphan Lake,* 1; Geary, 2. DOUGLAS COUNTY: *3 mi. up Kansas River from Lawrence,* 1; Lawrence, 95 (3 USNM); *3 mi. SW Lawrence,* 4; *3 mi. S Lawrence,* 1; *3½ mi. S, 3 mi. W Lawrence,* 3; *7½ mi. SW Lawrence,* 3; 2 mi. S, 3 mi. W Clinton, 1; *no specific locality,* 21. ELLIS COUNTY: Hays, 7 (FHSC). GREENWOOD COUNTY: Hamilton, 34; 8 mi. SW Toronto, 1; *8½ mi. SW Toronto,* 19; *no specific locality,* 2. HAMILTON COUNTY: 1 mi. E Coolidge, 2. JACKSON COUNTY: 3½ mi. SW Muscotah, 4. JEWELL COUNTY: sec. 1, R. 6 W, T. 1 S, 2 (FHSC). KEARNY COUNTY: Lakin, 1 (KSU). LABETTE COUNTY: 10 mi. SW Oswego, 1. LYON COUNTY: Emporia, 10 (ESC).

LEAVENWORTH COUNTY: Ft. Leavenworth, 3; *no specific locality,* 1. MEADE COUNTY: Fowler, 1; Meade County State Park, 3; *14 mi. SW Meade,* 1; *17 mi. SW Meade,* 1. MONTGOMERY COUNTY: 4½ mi. NNW junction U. S. 75 and 160, Independence Twp., 4; 4 mi. N Caney, 2; *4 mi. NW Caney,* 1. RILEY COUNTY: 4 mi. S Randolph, 1; Manhattan, 1 (KSU). SALINE COUNTY: 5 mi. N, 3 mi. W Salina, 1. SCOTT COUNTY: 8 mi. S, 4 mi. W Scott City, 1 (FHSC). SEDGWICK COUNTY: Wichita, 10 (6 FHSC); Haysville, 1 (FHSC). SHAWNEE COUNTY: 1 mi. W Topeka, 3. SMITH COUNTY: Kensington, 4 (FHSC). STAFFORD COUNTY: Little Salt Marsh, 2. WILSON COUNTY: no specific locality, 5 (PSC). WYANDOTTE COUNTY: Kansas City, 1.

Other records.—DOUGLAS COUNTY (Cockrum, 1956:497): *3½ mi. NW Lawrence; 6 mi. NNE Lawrence; 7½ mi. W Lawrence; 6½ mi. SW Lawrence.* HARVEY COUNTY: 4 mi. N, ½ mi. W North Newton (Bethel College Collection). POTTAWATOMIE COUNTY: no specific locality (Cockrum, 1952:77). RICE COUNTY: Sterling (Loewen, 1934:258). SHAWNEE COUNTY: *Topeka* (Cragin, 1885:45). TREGO COUNTY: vicinity Wakeeney (A. B. Baker, 1889:57). WABAUNSEE COUNTY: no specific locality (Cragin, 1885:45). WOODSON COUNTY: Neosho Falls (Allen, 1894:153). County unknown: *Cimarron River* (Allen, 1894:153).

Lasiurus cinereus cinereus (Palisot de Beauvois, 1796)

Hoary Bat

Distribution in Kansas.—Migrant; probably state-wide in suitable habitats and seasons (see Fig. 8).

Lasiurus cinereus is one of the largest bats occurring in Kansas. Like its smaller relative, *L. borealis,* the hoary bat roosts principally in trees and is migratory. The winter range of North American populations of this species is in the southern United States and northern and central Mexico. The earliest record in the year from

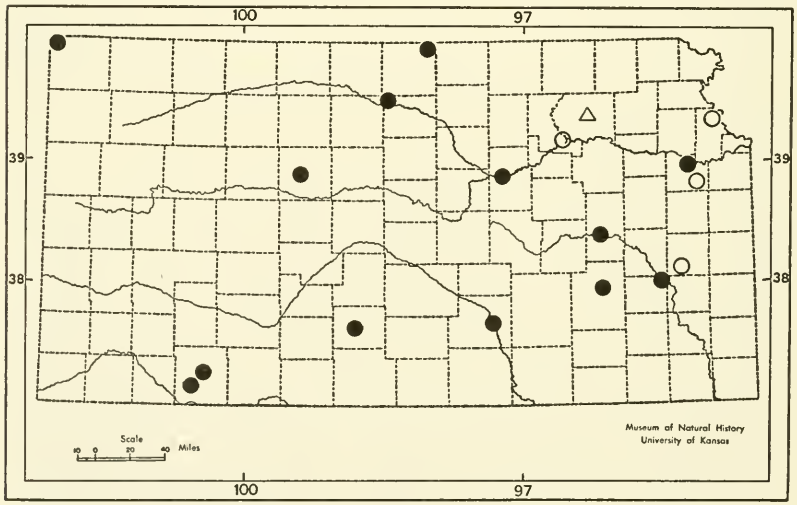

Fig. 8. Distribution of *Lasiurus cinereus cinereus* in Kansas. See Fig. 1 for explanation of symbols.

Kansas is of a female taken on March 26, 1953, in Cheyenne County (R. H. Baker, 1954) although many individuals evidently do not arrive until late in April or in May. The latest occurrence is provided by a female captured on September 27, 1965, at Hays. Although the hoary bat is widely distributed in Kansas, it is more numerous in the eastern part of the state than in the west and is nowhere so abundant as the red bat.

Findley and Jones (1964) have demonstrated that only females (and young of the year of both sexes in the late part of summer) are resident in Kansas and adjacent states. Males, some of which migrate through Kansas, spend the summer at higher altitudes or latitudes to the west or north of the state. The only adult male known from Kansas is a specimen obtained on May 25, 1942, at Hamilton, Greenwood County (the male from Lawrence, taken on June 30, that was reported as an adult by Cockrum, 1952:73, is clearly immature).

Females bear young in mid-June. Three with embryos (May 20-June 7) and nine with young (June 17-July 17) are on record from Kansas. The number was two in each instance except for one female accompanied by a single offspring.

Specimens examined (70).—CHEYENNE COUNTY: 12½ mi. N, 5½ mi. W St. Francis, 1. DICKINSON COUNTY: Abilene, 1. DOUGLAS COUNTY: Lawrence, 46 (1 ESC); *no specific locality,* 3. ELLIS COUNTY: Hays, 4 (FHSC). GREENWOOD COUNTY: Hamilton, 1. JEWELL COUNTY: sec. 1, R. 6 W, T. 1 S, 2 (FHSC). MEADE COUNTY: Meade, 1 (USNM); Meade County State Park, 2. MITCHELL COUNTY: Cawker City, 1 (FHSC). LYON COUNTY: Emporia, 2 (ESC). PRATT COUNTY: State Fish Hatchery, 2; *no specific locality,* 1 (ESC). SEDGWICK COUNTY: Wichita, 1 (KSU). WOODSON COUNTY: Neosho Falls, 1 (USNM). County unknown (Marshall or Washington): *Little Blue River,* 1 (USNM).

Other records.—ANDERSON COUNTY: Colony (Kellogg, MS). DOUGLAS COUNTY: Baldwin (Knox, 1875:20). LEAVENWORTH COUNTY: Ft. Leavenworth (Brumwell, 1951:209). POTTAWATOMIE COUNTY: no specific locality (Cockrum, 1952:75). RILEY COUNTY: Manhattan (Cragin, 1885:45).

Nycticeius humeralis humeralis (Rafinesque, 1818)

Evening Bat

Distribution in Kansas.—Known only by 13 specimens from Clay, Douglas, and Jewell counties; probably confined to eastern half of state, principally in timbered areas (see Fig. 9).

The first specimens of the evening bat taken in Kansas were four females collected 6 mi. SW Clay Center between June 25 and 30, 1937. Subsequently, single specimens were obtained in Douglas County in 1945, 1952, and 1955, and six females were collected in

northeastern Jewell County in June and September of 1964. Little is known of the habits of this species. It is thought to be migratory, to winter to the south of Kansas, and to roost primarily in hollows in trees and man-made structures. The earliest and latest dates of capture in the state are from Douglas County—a female carrying two embryos (5 mm. crown-rump length) taken on May 25 and a male that was shot as it chased another bat over a clearing on October 19. A female taken on June 9 in Jewell County was lactating.

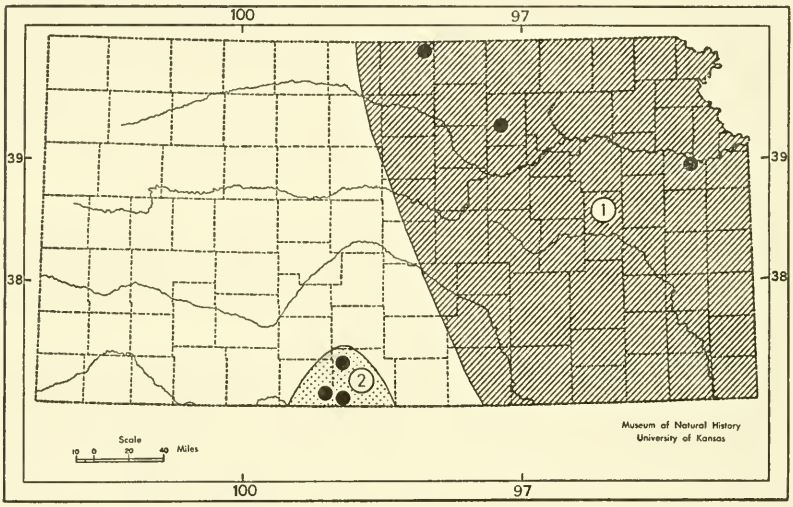

FIG. 9. Distribution of *Nycticeius humeralis humeralis* (1) and *Plecotus townsendii pallescens* (2) in Kansas. See Fig. 1 for explanation of symbols.

All specimens from Kansas are females save for the October-taken male, which has unworn teeth and may well have been born earlier in the same year. Similarly, all specimens of *N. humeralis* known from Nebraska are females or young. These data, together with other published information, suggest that adult males may not accompany females in spring to at least some parts of the warm-weather range of the species.

[After this account was prepared, a female evening bat was captured on October 12, 1966, in a residence in Overland Park, Johnson County. This specimen subsequently was deposited in the Museum of Natural History by T. H. Kunz.]

Specimens examined (13).—CLAY COUNTY: 6 mi. SW Clay Center, 4. DOUGLAS COUNTY: Lawrence, 2; *7½ mi. SW Lawrence,* 1. JEWELL COUNTY: sec. 1, R. 6 W, T. 1 S, 6 (FHSC).

Plecotus townsendii pallescens (Miller, 1897)

Long-Eared Bat

Distribution in Kansas.—Known only from Barber and Comanche counties in south-central part of state (see Fig. 9).

Although relatively rare, this species is resident the year around in south-central Kansas. Individuals are found primarily in caves and caverns, but we know of one female obtained from the attic of an abandoned building in Barber County.

Long-eared bats frequently are found singly (exceptions are maternity colonies and occasional small clusters of hibernating individuals), both in summer and winter, hanging from ceilings or walls of caves in relatively dry places. *Plecotus* associates in hibernation with *Pipistrellus subflavus, Eptesicus fuscus, Antrozous pallidus,* and *Myotis velifer;* Twente (1955b:721, 724) has extensively studied selection of hibernating sites. As noted by Twente (1955a: 380), the long-eared bat tends to awaken more quickly when disturbed than do some of the other cave-dwelling bats.

Records of banded individuals indicate considerable local movement from one small cave to another within the range of this bat in Kansas. A summer population of 300 to 500 individuals was estimated by Twente (1955a:387) for Barber and Comanche counties and the adjacent area in Woods County, Oklahoma. In Kansas, females give birth to a single young in late June or early July.

Another subspecies of this species, *Plecotus townsendii ingens* (Handley, 1955), has been taken in Washington County, Arkansas, and in Stone County, Missouri (see Handley, 1959:189-190), each some 85 miles distant from the southeastern corner of Kansas. *P. t. ingens* is to be looked for in natural caves and abandoned mines in the southeastern counties.

Specimens examined (40).—BARBER COUNTY: Sun City, 2 (USNM); *Havard Cave* [*2½ mi. SW Sun City*], 4 (3 KSU); *½ mi. E Havard Cave,* 1 (KSU); *4 mi. S Sun City* [*Triple Arch Cave*], 2; *Dancer's* (*or Sinkhole*) *Cave* [*4½ mi. S Sun City*], 4; *Natural Bridge* [*4½ mi. S, ¼ mi. E Sun City*], 2 (1 ESC); *Fallen Arch* [*5½ mi. S, ½ mi. E Sun City*], 1; *7½ mi. S Sun City,* 1 (FHSC); *2¼ mi. N, 19 mi. W Medicine Lodge,* 1 (FHSC); *Stevens Cave, 18 mi. S Sun City,* 1; *first cave S of Stevens Cave,* 1; 20-21 mi. S Sun City, 2 (FHSC); *no specific locality,* 3 (2 ESC). COMANCHE COUNTY: Double-entrance "S" Cave, 6 mi. NW Aetna, 3; *Swartz Canyon, 4 mi. W Aetna,* 8; *Swartz Canyon,* 4.

Other records.—BARBER COUNTY (Twente, 1955b:712, unless otherwise noted): *National Gypsum Mine* [*2 mi. S, 1¼ mi. W Sun City*]; *May Cave* [*4 mi. S Aetna*]; *Lost Colony Cave* [*¾ mi. SW May Cave*]; *cave 1 mi. S Lost Colony Cave* (Twente, 1955a:380). COMANCHE COUNTY: *Natural Bridge, Hanging Fence Canyon* (band record).

Antrozous pallidus bunkeri Hibbard, 1934

Pallid Bat

Distribution in Kansas.—Presently known only from western Barber County, but probably occurs also in at least adjacent Comanche County (see Fig. 10).

The pallid bat first was reported from Kansas by Hibbard (1933) and for many years was known only from the "Natural Bridge" south of Sun City, where specimens were taken only "during migration" in late August or early September of 1933, 1935, and 1939 (Hibbard, 1944). Twente (1955b:712) later reported that May Cave, 4 mi. S Aetna, was used as a hibernaculum by *Antrozous* and that an unusued barn at Aetna served as a summer residence. In late June of 1953 the barn contained an estimated 150 adult females and 50 adult males, the females forming a maternity colony.

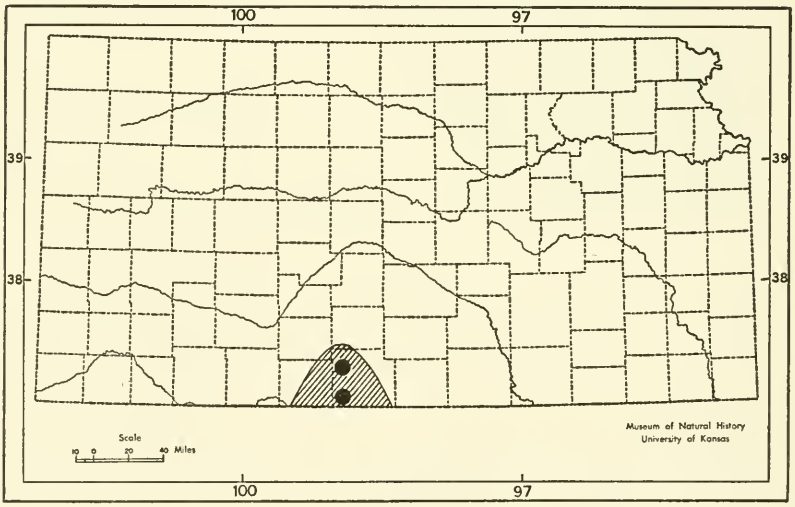

FIG. 10. Distribution of *Antrozous pallidus bunkeri* in Kansas. See Fig. 1 for explanation of symbols.

We are uncertain as to the status of the pallid bat in Kansas at this writing. None has been taken in recent years at the Natural Bridge. This land mark collapsed in 1962, although a tunnel there, probably the same one described as harboring *Antrozous* by Hibbard (1933:234 and elsewhere), remains intact. In December, 1964, we found only one living pallid bat in May Cave but found a number of scorched carcasses below a large crevice where the colony evidently had been hibernating. Later, we learned that

"about 200" had been "burned out" of the crevice in late November of that year by local ranch hands. Since that time, several visits to the barn at Aetna in spring and summer have failed to reveal a colony there. Twente (1955a:387) estimated the number of bats of this species in Barber County and adjacent Woods County, Oklahoma, to be between 200 and 400.

This bat was named as a distinct species by Hibbard (1934a: 227), but was reduced to subspecific status under *A. pallidus* by Morse and Glass (1960). As currently understood, the subspecies *A. p. bunkeri* ranges from the vicinity of Sun City southward to the Wichita Mountains of Oklahoma. The type locality of *bunkeri,* the "Natural Bridge" on the south fork of Bear Creek in Barber County, was said to be 7 mi. S Sun City in the original description. Actually, this former landmark properly is located as 4½ mi. S and ¼ mi. E of the center of Sun City (see Schoewe, 1949:fig. 35).

Specimens examined (103).—BARBER COUNTY: *"5½ mi. S Sun City"* [*approximately 4 mi. S Sun City*], 56; Natural Bridge [4½ mi. S, ¼ mi. E Sun City], 29; Aetna, 16 (13 FHSC); *1 mi. SW Aetna,* 2.

Other record.—BARBER COUNTY: *May Cave* [*4 mi. S Aetna*] (Twente, 1955b:712).

Family Molossidae

Tadarida brasiliensis mexicana (Saussure, 1860)

Brazilian Free-tailed Bat

Distribution in Kansas. — Probably state-wide as migrant or wanderer; no established colonies presently known from the state.

This free-tailed bat is a migratory, colonial species that utilizes caves, man-made structures, and occasionally crevices in rocks as summer roosting sites. Little yet is known about the location of winter quarters of free-tails that spend the summer as far north as Kansas but the meager data suggest they may move as far south as central Mexico.

We know of no permanent colonies in Kansas, although several formerly inhabited buildings in Medicine Lodge (Hibbard, 1936). The concentration nearest Kansas in the warm months is that at Merrihew Cave, three-quarters of a mile south of the Kansas (Barber County) line in Woods County, Oklahoma. As many as 100,000 *Tadarida* can be found in this cave at certain times in spring and again in late summer or early autumn. Probably the cave serves as a "staging area" in spring and prior to southward migration in autumn. Merrihew Cave serves also as an "overflow" maternity colony in some years—evidently when caverns farther south in

Oklahoma are occupied to capacity. This cave has harbored females with young in about half the years in the past decade. Bats that occupy Merrihew are known to forage northward into Kansas as far as Aetna.

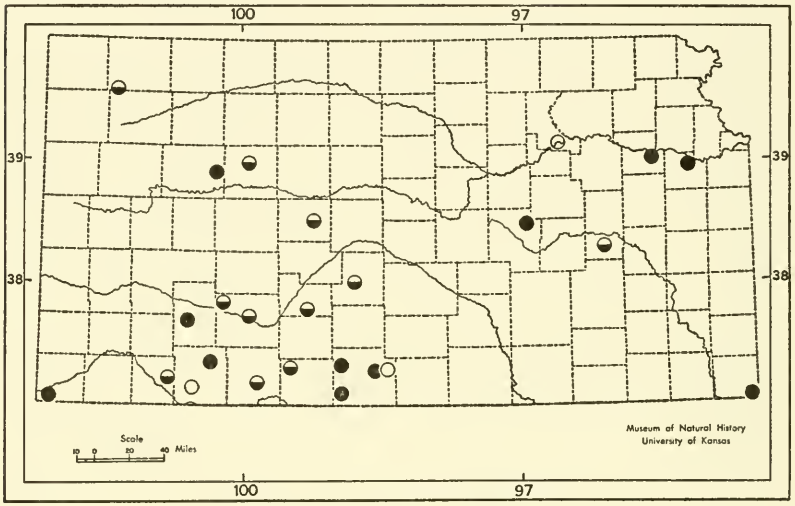

Fig. 11. Distribution of *Tadarida brasiliensis mexicana* in Kansas. See Fig. 1 for explanation of symbols.

When females bear young at Merrihew Cave they do so from late June through the first half of July (Twente, 1956).

A number of Brazilian free-tailed bats originally banded in northern Oklahoma have been recovered in Kansas in recent years (see Fig. 11 and records beyond). All of these were banded in Selman's Cave, Woods County, or Connor's Cave, Major County, by field parties from Oklahoma State University. Selman's Cave lies approximately 21 miles south of the Kansas (Comanche County) border, whereas Connor's Cave is about 45 miles south of the state (Barber County) line. Many of the returns are from localities to the north or northwest of the mentioned caves, and all appear to represent (irrespective of season or age) single individuals rather than bats taken from colonies or groups.

Ten of the 14 bats banded in Oklahoma and recaptured in Kansas were taken in late summer or early autumn (10 August to 12 October) in the year of their birth. Of these, the greatest distances of dispersal were registered by females banded at Selman's Cave. One, banded on July 9, 1962, was found in southwestern Rawlins

County (approximately 230 miles to the northwest of the cave) on September 4; the other, banded on July 5, 1956, was captured in Lyon County, 190 miles to the northeast, on September 16. Museum specimens from Meade County (August 31, 1964), Shawnee County (September 14, 1961—see also Long and Long, 1965), and Morton County (October 26, 1953) also are young of the year as judged by cranial and dental characteristics. It is obvious that most of the stations of known occurrence of this species in Kansas are represented by bats but a few months old that wandered northward after leaving the caves in which they were born. Glass (1959:543) suggested that such movements were "probably only indicative of a general scattering in late summer when numbers were at a maximum."

Aside from specimens taken from colonies formerly present in Medicine Lodge, we have examined the following adults from the state: female from Cherokee County, March 28, 1951; male and female from Gray County, March 30, 1955—see Anderson and Nelson, 1958:304; male from Marion County, August 15, 1936; female from Gove County, October 8, 1934. Four bats banded in Oklahoma, all females and all taken in June or early July in the year following their birth, have been recorded—one each from Edwards, Ford, Meade, and Seward counties. There is also to be considered the pregnant female taken at Lincoln, Nebraska, on June 27, 1931 (Jones, 1964:99).

Most of the adult bats recorded were captured in spring or early summer. It is not known whether these were wanderers, individuals in search of new summer quarters, or simply bats that, owing to some kind of navigational failure, "overshot" their intended destination in northward migration.

Specimens examined (31).—BARBER COUNTY: Havard Cave [2½ mi. SW Sun City], 2; Medicine Lodge, 18; Aetna, 2 (1 FHSC). CHEROKEE COUNTY: Galena, 1. DOUGLAS COUNTY: Lawrence, 1. GOVE COUNTY: Castle Rock, 1. GRAY COUNTY: R. 27 W, T. 29 S, 2. MARION COUNTY: Lincolnville, 1. MEADE COUNTY: 2 mi. N, 1 mi. W Fowler, 1. MORTON COUNTY: Elkhart, 1. SHAWNEE COUNTY: Tecumseh, 1.

Other records.—BARBER COUNTY: 3 mi. N, 2 mi. E Sharon (Loomis, 1956: 1327). CLARKE COUNTY: Ashland (band record). COMANCHE COUNTY: 6 mi. NW Coldwater (band record). EDWARDS COUNTY: 10 mi. N Greensburg (band record). FORD COUNTY: 15 mi. NW Dodge City (band record); Fort Dodge (band record). LYON COUNTY: 8 mi. S Emporia (band record—see also Glass, 1959:543). MEADE COUNTY: Meade County State Park (Getz, 1961:282). RAWLINS COUNTY: 25 mi. NW Colby (band record). RILEY COUNTY: Manhattan (Cragin, 1885:44). RUSH COUNTY: 4 mi. S, 2¾ mi. W Otis (band record). SEWARD COUNTY: Kismet (band record). STAFFORD COUNTY: St. John (band record). TREGO COUNTY: SW ¼ sec. 27, R. 23 W, T. 12 S (band record).

Tadarida macrotis (Gray, 1839)

Big Free-tailed Bat

Distribution in Kansas.—Known only from Morton County; to be looked for in any part of state (not mapped).

This species occurs from northern South America northward to the central United States (where it is known from Colorado, Iowa, Kansas, and Oklahoma) and to British Columbia. Probably it is migratory and certainly the center of abundance of *T. macrotis* lies to the south of the United States.

A single individual of unknown sex, which was found hanging on the inside wall of a silo 9 mi. N Elkhart in the autumn of 1950, is the only specimen known from Kansas. In the autumn of 1951, a female was taken 4 mi. S Elkhart, in Texas County, Oklahoma, providing the only specimen on record from that state.

The specific name *molossa* was applied to this monotypic species for some 20 years before Husson (1962) pointed out reasons necessitating return to use of the specific name *macrotis*.

KEY TO BATS OCCURRING IN KANSAS

The following key stresses external and easily observable dental characteristics with the hope that it will prove useful for ready identification of specimens in the flesh. Where cranial measurements or post-canine dental formulae are mentioned, it is to be remembered that it frequently is necessary to have a thoroughly cleaned skull in hand in order to appreciate the differential characters. When identifying bats, consult also the distribution maps in the foregoing text. Measurements are expressed in millimeters and are of adults; the measurement "greatest length of skull" includes incisors.

1. Tail extending conspicuously beyond free border of uropatagium; anterior border of ear with six to eight horny excrescenses; lower incisors bifed (Molossidae).

   2. Forearm more than 55; ear when laid forward extending well beyond tip of nose; greatest length of skull more than 21 *Tadarida macrotis*, p. 28

   2′. Forearm less than 48; ear when laid forward not extending beyond tip of nose; greatest length of skull less than 18 *Tadarida brasiliensis*, p. 25

1′. Tail not extending conspicuously (5 at most) beyond free border of uropatagium; no horny excrescenses on anterior border of ear; lower incisors trifed (Vespertilionidae).

   3. Single pair of upper incisors (total of 28-32 teeth).

4. Upper surface of uropatagium thickly furred; two pairs of upper premolars (total of 32 teeth).
   5. Dorsal pelage hoary (dark brownish tipped with grayish white); forearm more than 45; greatest length of skull more than 17.5 ..... *Lasiurus cinereus,* p. 20
   5′. Dorsal pelage reddish orange to yellowish brown; forearm less than 45; greatest length of skull less than 14.5 *Lasiurus borealis,* p. 17

4′. Upper surface of uropatagium naked or only thinly furred at base; one pair of upper premolars (total of 28 or 30 teeth).
   6. Dorsal pelage dark brownish [this bat superficially resembles *Myotis lucifugus*]; ear less than 15 from notch; three pairs of lower incisors (total of 30 teeth) . . *Nycticeius humeralis,* p. 21
   6′. Dorsal pelage yellowish brown; ear more than 25 from notch; two pairs of lower incisors (total of 28 teeth) *Antrozous pallidus,* p. 24

3′. Two pairs of upper incisors (total of 32-38 teeth).
   7. Dorsal pelage blackish frosted with white or, if not, ear elongate (more than 25 from notch); premolars $\frac{2}{3}$ (total of 36 teeth).
      8. Upper surface of uropatagium furred proximally for a third to a half of its length; dorsal pelage blackish frosted with white; ear less than 15 from notch *Lasionycteris noctivagans,* p. 12
      8′. Upper surface of uropatagium only thinly furred at base; dorsal pelage brownish; ear more than 25 from notch *Plecotus townsendii,* p. 23
   7′. Dorsal pelage not blackish frosted with white; ear less than 25 from notch; premolars $\frac{1}{2}$, $\frac{2}{2}$, or $\frac{3}{3}$ (total of 32, 34, or 38 teeth).
      9. Upper surface of uropatagium furred proximally for a third to a half of its length; dorsal pelage pale reddish brown; two pairs of upper premolars (total of 34 teeth) *Pipistrellus subflavus,* p. 13
      9′. Upper surface of uropatagium only thinly furred at base; dorsal pelage brownish or yellowish brown; one pair or three pairs of upper premolars (total of 32 or 38 teeth).
         10. Total length usually more than 110 (average about 120); greatest length of skull more than 18; premolars $\frac{1}{2}$ (total of 32 teeth) ..... *Eptesicus fuscus,* p. 15
         10′. Total length less than 110; greatest length of skull less than 18; premolars $\frac{3}{3}$ (total of 38 teeth).
            11. Dorsal pelage "woolly" in appearance and relatively thin; forearm more than 41; greatest length of skull more than 15.7.
               12. Dorsal pelage dark grayish brown; greatest length of skull less than 16.5 *Myotis grisescens,* p. 5
               12′. Dorsal pelage pale brownish; greatest length of skull more than 16.5 .... *Myotis velifer,* p. 11
            11′. Dorsal pelage thick, not "woolly" in appearance; forearm less than 41; greatest length of skull less than 15.7.

13. Dorsal pelage pale yellowish brown, contrasting noticeably with blackish ears and membranes; forearm usually less than 33.0; hind foot small, usually less than 8 from heel
Myotis leibii, p. 9

13'. Dorsal pelage brownish, not contrasting noticeably with ears and membranes; forearm more than 33.0; hind foot usually more than 8 from heel.

14. Ear 16 or more from notch, when laid forward extending well beyond tip of nose; maxillary tooth-row more than 5.5; mandibular tooth-row more than 6.9
Myotis keenii, p. 7

14'. Ear usually less than 15 from notch, when laid forward not extending noticeably beyond tip of nose; maxillary tooth-row less than 5.5; mandibular tooth-row less than 6.9 ..... *Myotis lucifugus*, p. 10

SPECIES OF POSSIBLE OCCURRENCE IN KANSAS

Of the bats known from the central United States that are yet unreported from Kansas, only one, *Myotis sodalis* Miller and Allen, 1928, seems likely to be found in the state. *M. sodalis* has been reported from central and southern Missouri and from northeastern Oklahoma and is to be looked for, particularly in caves and abandoned mines, in the southeastern counties. Of the species of *Myotis* so far reported from Kansas, *M. sodalis* most closely resembles *M. lucifugus*, but differs in having tricolored (rather than bicolored) pelage dorsally that imparts a pinkish gray or chestnut color to the dorsum, a smaller foot, and an evident keel on the calcar.

Other species that reach the Ozark Region and possibly (but doubtfully) will be found in southeastern Kansas are *Myotis austroriparius austroriparius* (Rhoads, 1897) and *Plecotus rafinesquii macrotis* (Le Conte, 1831). Several species of *Myotis* (for example, *M. evotis*) are known from within 100 miles or so of the western border of the state but, owing to ecological considerations, almost certainly do not occur in Kansas.

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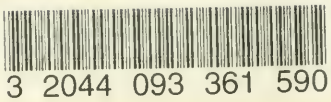
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